

## CLAIMS

What is claimed is:

1. A golf ball comprising:
  - 5 a center of one or more layers comprising a polybutadiene having a molecular weight of greater than about 200,000 and a resilience index of at least about 40;
  - a cover having at least one layer comprising a polyurethane composition formed from a prepolymer having no greater than 7.5 percent by weight unreacted isocyanate groups; and
  - 10 a wound layer comprising at least one thread material disposed between the center and the cover, each thread having at least one strand.
2. The golf ball of claim 1, wherein the cover comprises an inner cover layer and an outer cover layer, the inner cover layer being disposed between the wound layer and the outer cover layer.
3. The golf ball of claim 2, wherein the inner cover layer is harder than the outer cover layer.
4. The golf ball of claim 2, wherein the inner cover layer comprises at least one thermoplastic material.
5. The golf ball of claim 2, wherein the inner cover layer comprises an ionomer resin, a polyurethane, a polyetherester, a polyetheramide, a polyester, a dynamically vulcanized elastomer, a polyurea, a functionalized styrenebutadiene elastomer, a metallocene polymer, nylon, acrylonitrile butadiene-styrene copolymer, or a blend thereof.
6. The golf ball of claim 2, wherein the inner cover has an outer diameter of at least about 1.55 inches.
7. The golf ball of claim 2, wherein the inner cover has an outer diameter of about 1.58 to about 1.64 inches.

8. The golf ball of claim 1, wherein the polyurethane composition comprises at least one isocyanate, at least one polyol, and at least one curing agent.

9. The golf ball of claim 8, wherein the isocyanate comprises 4,4'-diphenylmethane diisocyanate, polymeric 4,4'-diphenylmethane diisocyanate, carbodiimide-modified liquid 4,4'-diphenylmethane diisocyanate, 4,4'-dicyclohexylmethane diisocyanate, *p*-phenylene diisocyanate, toluene diisocyanate, isophoronediiisocyanate, *p*-methylxylene diisocyanate, *m*-methylxylene diisocyanate, *o*-methylxylene diisocyanate, or a mixture thereof.

10. The golf ball of claim 8, wherein the at least one polyol comprises a polyether polyol, hydroxy-terminated polybutadiene, polyester polyol, polycaprolactone polyol, polycarbonate polyol, or mixtures thereof.

11. The golf ball of claim 8, wherein the curing agent comprises a polyamine curing agent, a polyol curing agent, or a mixture thereof.

12. The golf ball of claim 11, wherein the curing agent comprises a polyamine curing agent.

13. The golf ball of claim 11, wherein the curing agent comprises a polyol curing agent.

14. The golf ball of claim 1, wherein the prepolymer has from about 2.5 percent up to 7.5 percent by weight unreacted isocyanate groups.

15. The golf ball of claim 1, wherein the cover layer has a thickness of less than about 0.05 inches.

16. The golf ball of claim 1, wherein the inner cover layer has a thickness of less than about 0.05 inches.

17. The golf ball of claim 1, wherein the inner cover and outer cover layer have a combined thickness of less than about 0.07 inches.

18. The golf ball of claim 1, wherein the polybutadiene material in the center has a Mooney viscosity from about 40 to about 80.

19. The golf ball of claim 8, wherein the Mooney viscosity is from about 45 to about 60.

20. The golf ball of claim 1, wherein the polybutadiene has a vinyl-isomer content of less than about 2 percent by weight.

21. The golf ball of claim 1, wherein the polybutadiene has a *cis*-isomer content of at least about 95 percent by weight.

22. The golf ball of claim 1, wherein the center has an outer diameter of at least about 1.3 inches.

23. The golf ball of claim 1, wherein the center comprises a material formed from a conversion reaction of polybutadiene having a first amount of *trans*- isomer, a free radical source, and at least one *cis-to-trans* catalyst.

24. The golf ball of claim 23, wherein the reaction occurs at a temperature and for a time sufficient to form a polybutadiene reaction product having a second amount of *trans*- isomer greater than the first amount of *trans*- isomer.

25. The golf ball of claim 23, wherein the *cis-to-trans* catalyst comprises at least one of an organosulfur compound, an inorganic sulfur compound, an aromatic organometallic compound, a metal-organosulfur compound, tellurium, selenium, elemental sulfur, a polymeric sulfur, or an aromatic organic compound.

26. The golf ball of claim 1, wherein the polyurethane is thermoplastic or thermoset.

27. The golf ball of claim 1, wherein a coefficient of restitution of the golf ball when struck with a golf club head at 160 ft/s is at least about 0.76 and the

magnitude of the gradient of the coefficient of restitution to an inbound velocity is at least about 0.001 s/ft.

28. A golf ball comprising:

a center comprising a polybutadiene having a molecular weight of greater than about 300,000 and a resilience index of at least about 40;

a wound layer surrounding the center, having an outer diameter of at least about 1.51 inches, and comprising at least one thread material disposed between the center and the cover, each thread having at least one strand;

an inner cover layer surrounding the outer core layer; and

an outer cover layer disposed around the inner cover layer, the outer cover layer comprising a polyurethane composition formed from a prepolymer having less than 7.5 percent by weight unreacted isocyanate groups.

29. A golf ball comprising:

a center comprising a polybutadiene having a molecular weight of greater than about 300,000 and a resilience index of at least about 40;

a hoop stress layer surrounding the center, having an outer diameter of at least about 1.51 inches, and disposed between the center and the cover, wherein the hoop stress layer comprises a glass, polyamide, aromatic polyamide, carbon, or metal fiber having a tensile strength of at least about 250 kpsi and a modulus of at least about 10,000 kpsi; and

a cover having at least one layer disposed around the wound hoop stress layer, the cover comprising a polyurethane composition formed from a prepolymer having less than 7.5 percent by weight unreacted isocyanate groups.

30. A golf ball comprising:

a center;

a wound layer surrounding the center;

an inner cover layer surrounding the wound layer and having a first hardness; and

an outer cover layer surrounding the inner cover layer and having a second hardness less than the first hardness and having a thickness of less than about 0.05 inches.

31. The golf ball of claim 30, wherein the inner cover is less than about 0.05 inches.

32. The golf ball of claim 30, wherein the inner cover comprises at least one ionomer.

33. The golf ball of claim 30, wherein the outer cover comprises at least one castable material.

34. The golf ball of claim 30, wherein the at least one castable material comprises a thermoset or thermoplastic polyurethane composition.

35. The golf ball of claim 34, wherein the polyurethane composition comprises at least one isocyanate and at least one curing agent.

36. The golf ball of claim 35, wherein the isocyanate comprises 4,4'-diphenylmethane diisocyanate, polymeric 4,4'-diphenylmethane diisocyanate, carbodiimide-modified liquid 4,4'-diphenylmethane diisocyanate, 4,4'-dicyclohexylmethane diisocyanate, *p*-phenylene diisocyanate, toluene diisocyanate, isophoronediiisocyanate, *p*-methylxylene diisocyanate, *m*-methylxylene diisocyanate, *o*-methylxylene diisocyanate, or a mixture thereof.

37. The golf ball of claim 35, wherein the curing agent comprises a polyamine curing agent, a polyol curing agent, or a mixture thereof.

38. The golf ball of claim 37, wherein the curing agent comprises a polyamine.

39. The golf ball of claim 37, wherein the curing agent comprises at least one polyol.

40. The golf ball of claim 39, wherein the at least one polyol comprises a polyether polyol, hydroxy-terminated polybutadiene, polyester polyol, polycaprolactone polyol, polycarbonate polyol, or mixtures thereof.

41. The golf ball of claim 30, wherein the inner cover and outer cover layer have a combined thickness of less than about 0.07 inches.

5 42. The golf ball of claim 30, wherein the center comprises a material formed from a conversion reaction of polybutadiene having a first amount of *trans*- isomer, a free radical source, and at least one *cis-to-trans* catalyst.

10 43. The golf ball of claim 42, wherein the reaction occurs at a temperature and for a time sufficient to form a polybutadiene reaction product having a second amount of *trans*- isomer greater than the first amount of *trans*- isomer.

15 44. The golf ball of claim 42, wherein the *cis-to-trans* catalyst comprises at least one of an organosulfur compound, an inorganic sulfur compound, an aromatic organometallic compound, a metal-organosulfur compound, tellurium, selenium, elemental sulfur, a polymeric sulfur, or an aromatic organic compound.